

Implants in the severely resorbed mandibles: whether or not to augment? What is the clinician's preference?

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Abstract

Introduction The aim of this study is to inventory in the Netherlands which therapy is the clinician's first choice when restoring the edentulous mandible.

Material and methods A questionnaire was sent to all Dutch Oral and Maxillofacial surgeons. As part of this, the surgeons were invited to treat five virtual edentulous patients, differing only in mandibular residual height.

Results In cases of a sufficient residual height of 15 mm, all surgeons were in favour to insert solely two implants to anchor an overdenture. In case of a residual height of 12 mm, 10% of the surgeons choose for an augmentation procedure. If a patient was presented with a mandibular height of 10 mm,

already 40% of the OMF surgeons executed an augmentation procedure. Most (80%) surgeons prefer the (anterior) iliac crest as donor site. The choice of 'whether or not to augment' was not influenced by the surgeon's age; however, the hospital, where he was trained, did. Surgeons trained in Groningen were more in favour of installing short implants in mandibles with reduced vertical height.

Discussion As the option overdenture supported on two interforaminal implants is reimbursed by the Dutch health assurance, this treatment modality is very popular in the Netherlands. From a point of costs and to minimize bypass comorbidity, surgeons should be more reluctant in executing augmentation procedures to restore the resorbed edentulous mandible as it is dated in literature that also in mandibles with a residual height of 10 mm or less, solely placing implants, thus without an augmentation procedure in advance, is a reliable treatment option.

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Introduction

As the dimension of the alveolar ridge is dictated by the presence of teeth, their absence induces alveolar bone resorption. In the case of complete edentulism, replacement of the natural teeth by a denture does not stop the process of continuous bone resorption. In the contrary, as a result of the unfavourable forces introduced by the denture itself, resorption of the alveolar ridge is accelerated [1]. Lack of retention of the denture, pain, eating and speech difficulties, reduced facial height, relative prognathism and collapse of lower facial soft tissue with consequential altered appearance are the common problems that patients have to deal with.

Endosseous implants increase the stability of the denture, thereby solving a part of the above-mentioned problems. However, installing implants is only feasible if adequate alveolar bone volume is present. In case of extreme resorption of the mandible, the choice of treatment on how to restore a deficit in bone volume is still subject of discussion. Many strategies with their own specific advantages and disadvantages have been published [2, 3]. As such, for example, sulcoplasties have been proposed; by lowering of the muscular attachments of the lip, eventually in combination with releasing the mylohyoid muscle, the denture bearing area of the mandible can be enlarged [4–6].

To increase the mandibular bone volume, various augmentation procedures, such as onlay [7, 8], sandwich [9], visor [10] or submental [11] approaches, have been suggested, using an autologous bone graft or bone substitute as augmentation material. An alternative approach is the technique of alveolar distraction osteogenesis, creating an increase in bone volume without the use of bone substitutes or bone grafts [12–17]. An interesting topic is, at what point the bone volume is still thought to be sufficient to allow implant placement and at what point it is not. Nowadays, there is a tendency to use shorter implants, thereby reducing the indication for augmentation procedures [18, 19].

The aim of this study was to survey which procedure related to the extremely resorbed mandible is preferred at the present time. The extremely resorbed mandible was defined as a mandibular height in the symphyseal area of 12 mm or less as measured on a standardized lateral cephalogram (Fig. 1). At what mandibular height the clinician decides not only to install implants but also to perform an augmentation procedure. Does age of the surgeon, location of former training and present professional setting influence the choice of treatment? Is there a tendency to add more implants when the residual ridge decreases in height?

To survey which therapy clinicians prefer in case of an extremely resorbed mandible, a questionnaire was sent to all Dutch Oral and Maxillofacial (OMF) surgeons. Besides education and experience, all surgeons were asked to treat five virtual edentulous patients, presenting various mandibular heights.

Material and methods

Questionnaires were mailed to all 198 OMF surgeons working on 58 hospitals housing departments of OMF Surgery in the Netherlands. Of these, 129 surgeons (65%) responded.

The questionnaire comprised two parts; the first dealt about ‘age’, ‘location of former training’ and ‘present professional setting’, such as university, general hospital or private practice. Questions were asked about the surgeons’

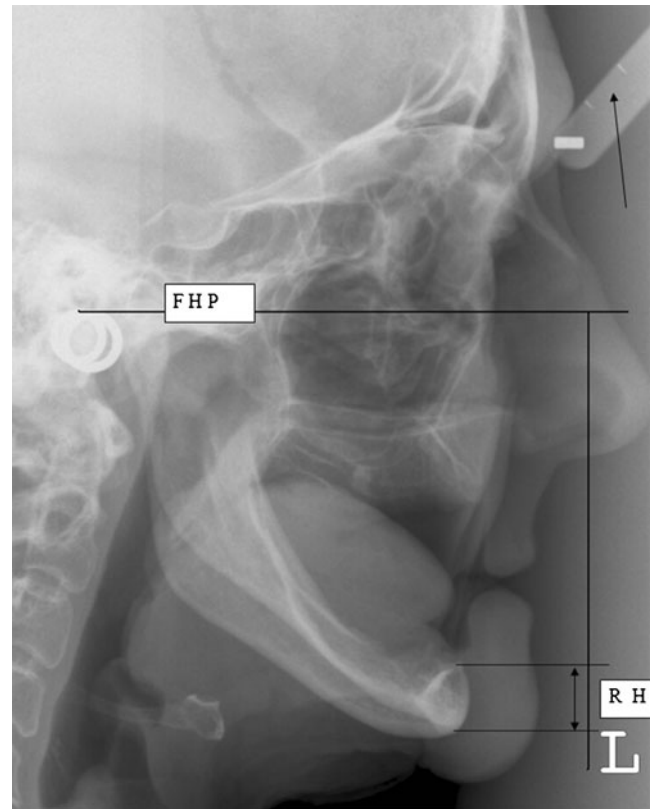


Fig. 1 An edentulous patient. *RH* residual height in symphyseal area, in this study varying between 15 and 6 mm

preference for a certain surgical strategy in case of a resorbed edentulous mandible (see questionnaire part I).

To further inventory the surgeons’ preference, in the second part of the questionnaire, five imaginary complete edentulous patients were presented; the only parameter that varied was the mandibular height. Patient 1 represents a residual bone height in the symphyseal area of 15 mm, patient 2 of 12 mm, patient 3 of 10 mm, patient 4 of 8 mm and patient 5 of 8 mm. All virtual patients were in good general health, edentulous, showing a small zone of attached gingiva in combination with a shallow vestibular sulcus. Of course, all patients suffered from retention problems of their dentures. Schematic cross sections were depicted to represent the atrophic mandibles, as is shown by the Lateral Cephalometric Radiography: bone height varied from 8–15 mm (Fig. 1). The OMF surgeon was challenged to make an adequate treatment plan for these virtual patients.

The surgeon was faced up to choose, or solely for inserting implants, or to execute an augmentation procedure in advance (see questionnaire II). In addition, the preferred number of implants was asked for as also the method of augmentation. In the latter case, it was inventoried if autologous bone was liked superior than bone substitutes.

Statistics

For data analysis, the statistical analysis software package SPSS 16.0.01 was used. An independent sample *t* test was applied to analyse the relation between differences in treatment plans and ‘age of the surgeon’. All other background properties of the OMF surgeons were coded as nominal variables and, therefore, the relation between these and differences in treatment plans were analysed using the Chi-square test, supplemented with the Fisher’s exact test.

Results

Regarding the first part of the questionnaire, the mean age of the respondents was 46.5 years, ranging from 29 to 62 years. Most (78.6%) were working in partnership in a general hospital. Respondents were allowed to choose more treatment possibilities for the same patient. Therefore, percentages may exceed 100% (Figs. 2, 3, 4 and 5).

The sulcoplasty, as a single surgical method to improve patient’s satisfaction, is hardly used anymore. However, in combination with, or as a secondary procedure after implant placement, the sulcoplasty has still an important role (52% of the respondents uses this method incidental, 18% regularly). To improve the available bone volume, 57% of the respondents are in favour of the onlay method (Fig. 2). As second best, the sandwich method is regularly used (10%). Only few colleagues are in favour of the submental method (5%) or the visor osteotomy (4%).

To harvest an autologous bone graft, 80% of the respondents are in favour of the (anterior) iliac crest as donor site. Only sparsely the tibia (1%) or cranium bone (1%) is chosen (Fig. 3).

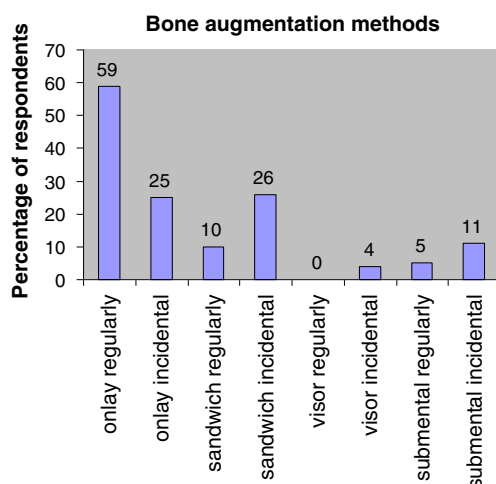


Fig. 2 Different bone augmentation methods used by Dutch OMF surgeons in cases of insufficient mandibular bone height

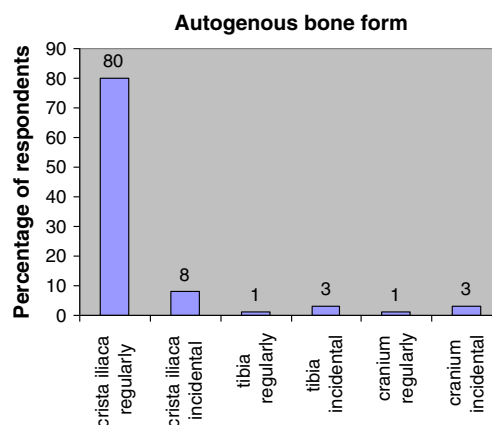


Fig. 3 The choice of Dutch OMF surgeons to harvest autologous bone grafts

As a bone substitute, Bio-Oss® is used regularly (39%), Cerasorb® sometimes (12%) and other bone substitutes hardly ever. As an augmentation technique, only few colleagues use vertical distraction regularly (12%) or incidentally (23%). Intraosseous distraction devices are more popular (19%) than extraosseous ones (3%).

For the edentulous mandible with sufficient bone height, placing two permucosal dental implants at the position of the former canines is preferred by most of the respondents (96%). However, also the option of three, four and six interforaminally placed implants was selected (Fig. 4).

A bar suprastructure with overdenture is the first choice (78%) followed by ball attachments (63%). Fixed bridge-work is not often indicated in the Netherlands (8%; Fig. 5).

With respect to the second part of the questionnaire, all five virtual patients, as presented, suffered from an atrophic mandible, a small zone of attached gingiva, a small vestibular sulcus and an insufficient retention of their lower dentures. The following results were found (Fig. 6):

Patient 1. Complete edentulism, bone height symphysis area of 15 mm.

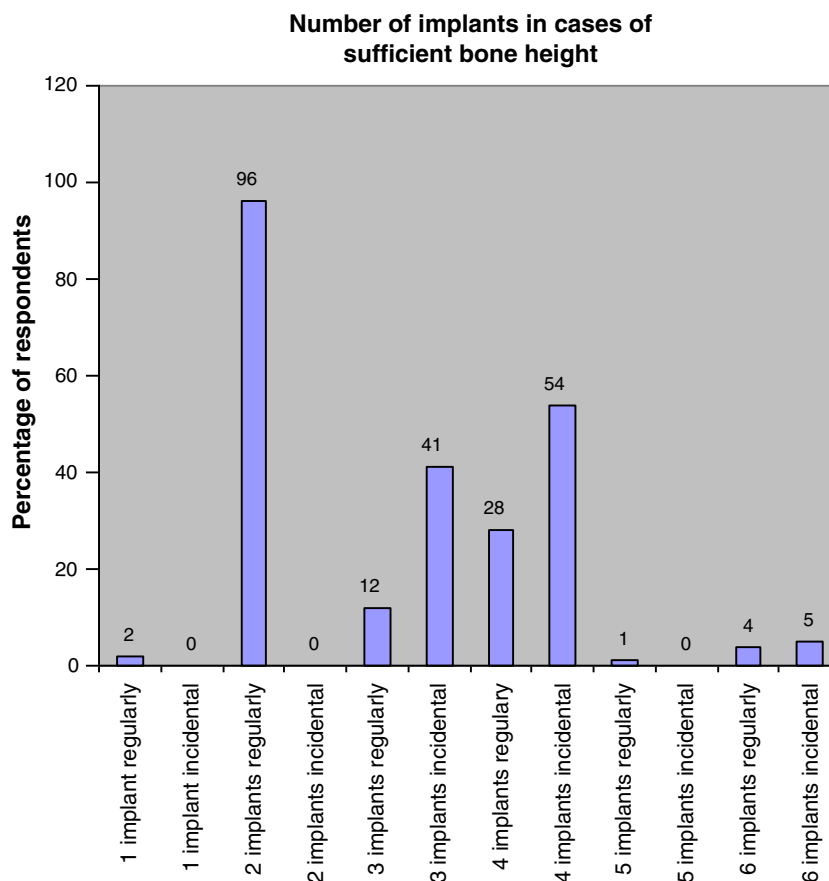
Most surgeons inserted two implants (85%). Others preferred three (6%), four implants (7%) or six implants (1%; Fig. 6). Sulcoplasty, as single therapy, was only chosen by one surgeon.

Patient 2. Complete edentulism, bone height symphysis area of 12 mm.

Again, most surgeons inserted two implants (65%) as others inserted three implants (10%), four implants (14%) or six implants (1%). In this case, 10% of the surgeons preferred to augment the mandible in advance of implant placement using autologous bone as an onlay graft (Fig. 6).

Patient 3. Complete edentulism, bone height symphysis area of 10 mm.

Fig. 4 Number of implants placed in the edentulous mandible



Also, in the case of a mandibular height of 10 mm, placing solely implants is the first choice for 60% of the surgeons; most inserted two implants (28%), others three implants (11%), four implants (19%) or even six implants (1%; Fig. 5). Already 40% of the surgeons were in favour of an augmentation procedure in advance of implant placement; 28% for the onlay procedure, 6% for the sandwich method, 2% for the submental augmentation and 4% for the distraction procedure.

Patient 4. Complete edentulism, bone height symphysis area of 8 mm.

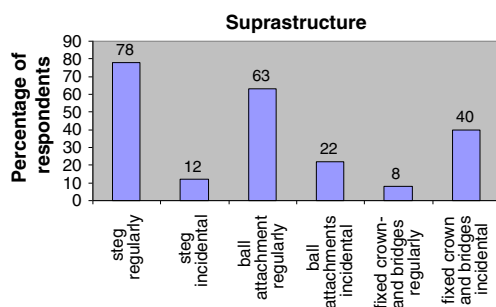


Fig. 5 Suprastructure on implants in the edentulous mandible

The majority of the respondents (71%) were in favour of first augmenting the mandible; 52% preferred the onlay procedure, 10%, the sandwich method, 4%, the submental augmentation and 5%, the distraction procedure. Just installing two implants without pre-implant surgery was suggested by 11% of the surgeons, three implants by 4% and four implants by 13% of the colleagues (Fig. 6).

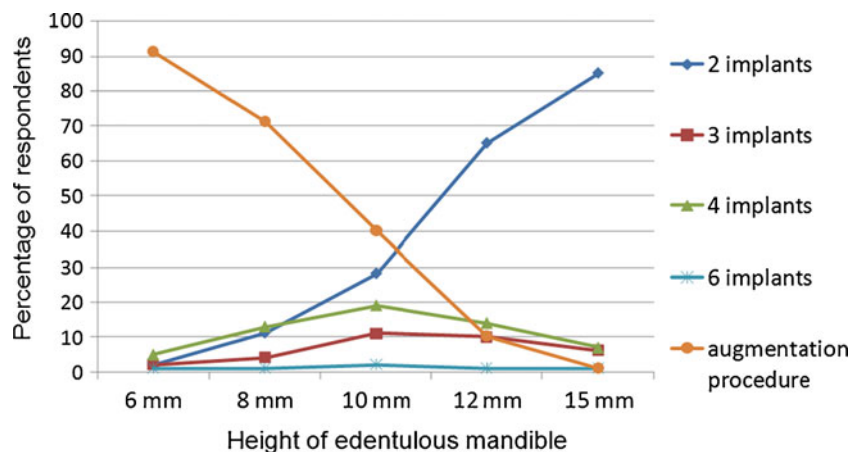
Patient 5. Complete edentulism, bone height symphysis area of 6 mm.

Only 9% of the respondents choose for implant placement without augmentation procedures; 2% preferred the option of two or three implants, 5% choose for four implants. The majority (91%) liked to improve the vertical height in advance of implant placement (Fig. 5); with an onlay graft (64.1%), sandwich method (8%), submental augmentation (8%) or vertical distraction (2%).

Statistical testing

Neither 'age of surgeon' nor the variables 'location of former training' and 'present professional setting'

Fig. 6 The choice of Dutch OMF surgeons to place two, three, four or six implants or to first restore the available bone volume in relation to the vertical residual bone height



showed a statistical significant relation with the choices made in the five patients, with one exception: in patients with a mandibular height of 10 mm, OMF surgeons, educated in Amsterdam and Groningen, preferred to insert implants, whereas the OMF surgeons trained at other locations favoured to augment the mandible first ($p=0.029$).

Discussion

In the Netherlands, for implant surgery, patients are referred to the OMF surgeon. After implant placement, the prosthetic rehabilitation is executed by the referring dentist; therefore, also the choice of suprastructure is in his hands. In general, as is also shown in the present study, installing just two implants is the first treatment of choice. This approach is less time-consuming, easy to perform with relatively low costs. In the Netherlands, each person is obliged to be assured for medical costs. In addition, the option of placing two interforaminal implants, the suprastructure and denture inclusive, is covered by the health assurance. Based on surveys of current literature, a consensus statement corroborates that there is now overwhelming evidence that a two-implant overdenture should be the first choice of treatment for the edentulous mandible [20]. Surprisingly, in other countries like Sweden, mainly implant-borne fixed restorations are placed in the edentulous mandible. This phenomenon is mainly explained by the generous Swedish dental insurance system making fixed restorations available to most patients. The higher rate of edentulism and a more established tradition of removable dentures in the Netherlands than in Sweden may further explain the differences in treatment between the two countries [21]. To date, the Dutch insurance companies reimburse most costs of implant overdentures in edentulous people, whereas there is no reimbursement for fixed restorations. This may

explain the preference in choice for treatment; for a relative simple overdenture in the Netherlands versus complete pre-implant rehabilitation using augmentation procedures in combination with fixed and sometimes immediate loaded appliances in other countries [22, 23].

The outcome of the questionnaires shows that the sulcoplasty, as a single surgical method, is hardly used anymore. Nowadays, the most favourable approach to restore retention of a denture is to insert two implants. From review of the literature, it seems evident that many treatment concepts involving mandibular overdentures supported by endosseous implants are based on empirical experiences or are merely on opinions of members of individual centres [22]. If the patient desires increased stability of the mandibular denture and improved chewing ability, two implants connected by a bar in the interforaminal region supporting an overdenture are sufficient as a general rule. However, when using only two implants, a rotational movement of the denture is still feasible because the denture is supported by both the mucosa and the implants. To increase the stability of the denture, more implants can be placed, thereby making the denture completely implant-borne [24].

This article inventories at what mandibular height clinicians choose for first executing an augmentation procedure before installing implants (Fig. 6). In the case of a mandibular height of 12 and 15 mm, both in the questionnaire as in the treatment of the virtual patients, the majority of the respondents prefer the option of inserting solely two implants. In the case of a vertical bone height of 10 mm, the choice for first performing an augmentation procedure became real. Already 40% of the respondents choose for augmenting the mandible in advance of implant placement. The other 60% were in favour of just installing implants. About the topic at what mandibular height an augmentation procedure is required, literature is not conclusive. Although numerous studies have described the

outcome results of dental implants in the edentulous mandible, there have been few prospective studies designed as randomized clinical trials that compare different treatment modalities to restore the severely resorbed mandible. As such, in a prospective study, Stellingsma et al. (2004) compared three treatment methods in patients with an average mandibular bone height of 9.7 ± 1.4 mm [24]. In one group, they installed four short implants; in another group, first an onlay procedure was performed after which four regular-sized implants were placed in a secondary procedure. In the latter group, 10% of the implants have been lost compared to 0% in the group installing just four short implants. Also, retrospective studies [25, 26] showed acceptable survival rates of between 92% and 94% survival rate after 10 years of loading using at least four short implants to support a fixed implant-supported prosthesis or overdentures. In the study of Deporter et al. (2002), overdentures were supported by three short implants showing a survival rate of 93% after 10 years. [27] The question pops up if these successes also will be achieved if installing just two implants.

For the virtual patient having a low mandibular height (6 or 8 mm), a minority of the respondents (29% and 9%, respectively) choose for solely implant placement. Besides the risk of implant loss, also the mandible may fracture. However, this risk is relatively low. Recently, an inventory by Soehardi et al. on the number of fractures that occurred in conjunction with implants placed in edentulous patients in the Dutch population during the period 1980–2007 elucidated an incidence of only 0.033% [28]. Nevertheless, it was stressed that if a fracture does occur, this complication is difficult to treat [16, 28].

To improve the available bone volume, most of the respondents are in favour of the onlay method using iliac crest bone. The disadvantage of harvesting a bone graft is obvious; it demands an extra operation resulting in a prolonged operation time, extra costs and more morbidity. Therefore, a shift to using short implants is a logical next step.

An interesting point is that the age of the surgeon did not influence the choice whether “to augment or not”. This means that older surgeons evaluated their therapies to the present state of art in pre-implant surgery, and also that younger surgeons have probably less acquaintance to “older” techniques like sulcoplasties, visor or sandwich augmentations. Surprisingly, the ‘location of training’ was of significant influence. Surgeons trained in education clinics that advocate the placement of short implants followed the same strategy in the treatment of the virtual patient with a mandibular height of 10 mm.

Although numerous studies have described the outcome results of dental implants in the edentulous mandible, there have been few prospective studies designed as randomized clinical trials that compare different treatment modalities. There is a tendency to insert short implants in case the

mandibular height in full edentulous patients is even lower than 10 mm. In a recently published case report, even four implants with a length of only 5.5 mm in length were placed in an extremely resorbed mandible [29]. To bypass the comorbidity that is linked to augmentation procedures using autologous bone, future prospective studies should concentrate on the issue if placement of only two implants is a reliable option for the extremely resorbed edentulous mandible having a residual height of less than 10 mm.

In conclusion, a 12-mm residual bone height in the symphyseal area is the turning point for most of the colleagues whether to perform augmentation procedures or place solely implants. Ongoing research in favour of placing short implants will decrease this turning point, maybe even to a level of 8 mm residual bone height, or less, thereby reducing costs and patient morbidity.

Conflict of interest The authors declare that they have no conflict of interest.

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